CHAPTER 9

RASTER SCAN BLOCKS

9.1. Product Definition Blocks.

9.1.1. Satellite Product Definition Block. This block shall be formatted as shown in Figure 9-1. This block may be used to define all raster scan products that are in the form of visual imagery, i.e., satellite data as opposed to facsimile products.

9.1.2. Pixel Product Definition Block. This block shall be formatted as shown in Figure 9-2. This block shall be used for all non-satellite raster scan products (such as radar or facsimile). This block may also be used for satellite products in addition to, with, or instead of the Satellite Product Definition Block. The data may be packed to conserve transmission time. The algorithm used to pack the data shall be indicated by the pack code.

9.1.3. Polar/Geosynchronous Image Product Definition Block. This block shall be formatted as shown in Figure 9-4. This block identifies the image as a geosynchronous or polar satellite image. It identifies the image extents and organization used for extraction and display. This block identifies reference attributes common to both geosynchronous and polar satellite images.

9.2. Data Description Blocks.

9.2.1. Geosynchronous Image Data Description Block. This block shall be formatted as shown in Figure 9-5. This block identifies reference attributes specific to geosynchronous image products. It is used to establish an earth reference frame in the context of the image product described by the Image Product Definition Block (Mode 6/Submode 40). This block is also used to identify the type of sensor and data included.

To determine the earth location of points on a geostationary image for the purpose of overlaying meteorological symbols such as wind barbs or geopolitical information such as a state boundary it is necessary to be able to compute the line and pixel of the image that corresponds to a given point on the surface of the earth. This involves determining the location of the satellite in orbit and the earth point that the sensor was directed at and relating these to the earth latitude/longitude of the point and the image scanline/pixel. For more information see Earth Location Equations prepared for NASA, Goddard Space Flight Center by Westinghouse Electric Corporation (NASA Contract Number

NAS 5-23582.) The following parameters provide the information required that is not included in the image Product Definition Block (Mode 06/Submode 40.)

9.2.2. Polar Image Data Description Block. This block shall be formatted as shown in Figure 9-6. This block identifies reference attributes specific to polar image products. It is used to establish an earth reference frame in the context of the image product described by the Image Product Definition Block (Mode 6/Submode 40). This block is also used to identify the type of sensor and data included.

To determine the earth location of points on a polar orbiting satellite image for the purpose of overlaying meteorological symbols or geographical information it is necessary to compute the line and pixel of an image that relates to a given point on the Earth's surface. This involves determining the location of the satellite and the location where the sensor of the satellite was pointing when a particular sample was taken. These calculations involve relating the orbital mechanics of the satellite, the dynamics of the sensors motion and the rotational dynamics of the earth to the scanlines and pixels of the image.

9.3. Data Blocks.

9.3.1. Raster Scan Data Block

This Raster Scan Data block shall be formatted as shown in Figure 9-3. All raster scan products shall use this format with the XROW, YCOL, and RESOLUTION fields set to one (all bits on) if not used. The origin is 0,0. Pixel data in the data field shall be packed as specified by the pack code and arranged as specified by the pack code in the Product Definition block. The currently defined packing algorithms are described in succeeding sections.

9.3.1.1. Block Organization.

9.3.1.1.1. AFGWC Packing Scheme. Each data block shall contain a field giving the row and column location of the first pixel in the block and the resolution of the data, followed by a data field containing the pixel data. Succeeding pixels for the remainder of the scan line proceed as specified by the scan code. For multi-bit deep raster scan products, the pixel data shall consist of a pixel value for each pixel location. For single bit deep raster scan products, the pixel data shall specify state (on or off). The pixel data shall be organized in the data field as a continuous string of bits. The number of bits per pixel shall be specified by the matrix code, i.e., matrix code 01, 11, 21, 41 indicate one bit pixels, 04, 14, 24, 44, represent four bit pixels, etc.

9.3.1.1.2. National Weather Service Packing Scheme. Products packed in accordance with this scheme shall have the XROW, YCOL, and the resolution elements zero (0) filled. The data field shall be organized such that the pixel data is given in 8-bit bytes and packed within the bytes as follows:

Bit 7 and Bit 6 — These bits are never used.

Bit 5 and Bit 4 — These two bits determine the type of data described in the byte as follows:

00 = Number of consecutive pixels in the line in the ON (white) state.

01 = Number of consecutive pixels in the OFF (black) state.

10 = Unpacked pixel data.

11 = Recorder control character.

Bit 3 thru Bit 0 — These bits contain the pixel count, unpacked pixel data, or the control character's lower half. For pixel count, the bits give the number of pixels OFF or ON in groups of four pixels, as indicated by bits 2 and 3. For unpacked pixel data, they give the state (ON and OFF) of the next four pixels in the scan line. If the byte contains the end-of-scan (EOS) control character, bits 4 through 7 are off. If the byte contains the end-of-map (EOM) character, bits 4 and 5 are off and bits 6 and 7 are on.

One byte of the packed pixel data stream can represent, at most, sixty (4*15) pixels of all white or all black data (i.e., UU001111 or UU011111). If bits two and three are the same in two, and at most three, consecutive bytes (e.g., two or three bytes containing UUOO, or two or three bytes containing UU01), then the pixel count in the second byte represents multiples of sixteen, and the third, if present, represents multiples of sixteen squared. For example:

UU001010 UU000101 UU000001 = 10 + (5 * 16) + (1 * 256) = 346 groups = 1384 white pixels (346*4)

UU000111 UU010011 UU011100 UU110000 = 7 groups of white, 3 + (12 * 16) groups of black, and end of scan = 28 white pixels, 1780 black pixels and end of scan

Each block will contain one or more scan lines of the product (or partial lines) as required to fill the data block. Each complete scan line will be followed by an end-of-scan (EOS) sequence (UU110000). If a scan line is not completed before the last byte of a data block, the scan information will continue in the next block and the data shall be treated as if it had been in the same block. If an EOS is encountered before the end of a scan line, then the remainder of the scan line is white, and the next byte begins the next scan line. The final EOS for the product will be followed by an end-of-map (EOM) sequence (UU110011). If the EOM sequence is reached before the end of a data block, the remainder of the block will be filled with EOM sequences and the next block will be the End of Product block.

9.3.1.2. Block Length.

9.3.1.2.1. Air Force Global Weather Central (AFGWC) Packing Scheme. Data blocks will be of fixed length for a given product as determined by the number of pixels required to define one complete scan line of the product. Data block length shall be variable from one product to another depending on the size of the product. For example, one product may be a 512 x 512 bit array and another may be a 1024 x 1024 x 6 array.

9.3.1.2.2 National Weather Service Packing Scheme. Data blocks will be of fixed length for a given product. For example, NWS pixel products are blocked into 960 byte strings. Each block may contain any number of complete or partial scan lines as required to fill the block. Data block length will be variable from one product to another.

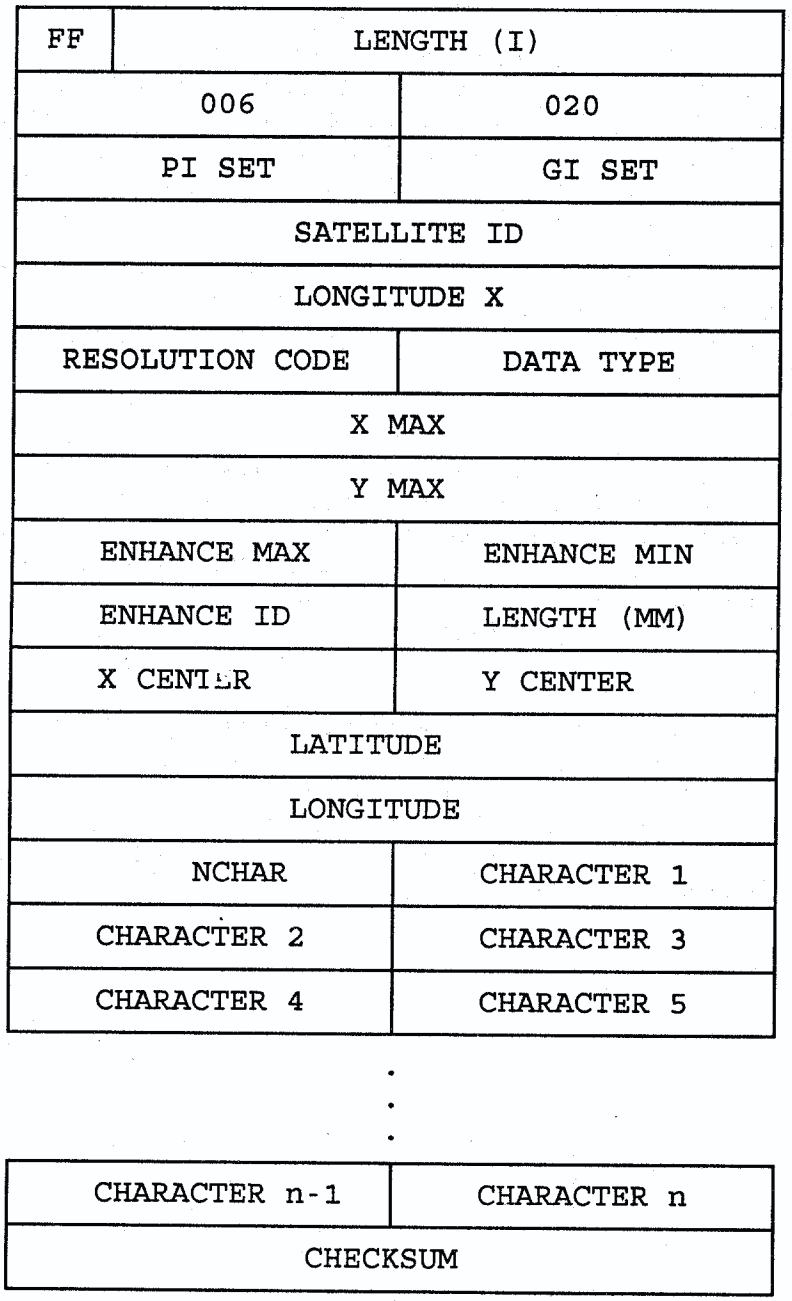


Figure 9-1. Satellite Product Definition Block; Mode 6, Submode 20

NOTES: Figure 9-1:

1. PI SET: The PI SET defines the background projection on which the product is valid. The currently defined codes are shown in Table C2-1. If a product is not associated with a background, PI SET will be zero (0) filled.

2. GI SET: The Grid Indicator defines the grid on which the data is valid. Currently defined codes are shown in Table C2-3. If a product is not associated with a GI SET, this field will be zero (0) filled.

3. SATELLITE IDENTIFICATION: Two ASCII characters that identify the satellite from which the product was produced. The first character identifies the agency. Currently assigned values are:

A - Air Force
C - China
E - European
I - Indian
J - Japan
N - NOAA
R - Russian
S - NASA
V - Navy

The second byte may contain a letter or number to designate a specific satellite.

4. LONGITUDE X: This is the longitude of the meridian perpendicular to the base of the product and extending from the base of the product to the pole. Longitude X may be outside of the product boundaries. Table C2-1 shows the Longitude X for the defined PI Sets (map projection).

5. RESOLUTION CODE: This element specifies the resolution of the satellite data in the product in tenths of nautical miles, i.e., the resolution must be multiplied by .1 to obtain the actual value.

6. DATA TYPE: An integer code that specifies the type of satellite data contained in the product. The currently defined codes are:

0 = Visual (VIS) only
1 = Infrared (IR) only
2 = Alternating lines of IR/VIS both day or both night
3 = Alternating bytes IR/VIS both day or both night
4 = Alternating lines of night and day both IR or both VIS
5 = Alternating bytes of night and day both IR or both VIS
6 = Microwave
7 = Water Vapor

7. XMAX and YMAX: The maximum horizontal (XMAX) and vertical (YMAX) size of the product in pixels.

8. ENHANCE MAX and MIN: The limits of the gray scale referenced by ENHANCE ID.

9. ENHANCE ID: An enhancement identification which points to a table of gray scales or an algorithm. Some values are common for interagency use and some are user defined.

Figure 9-1. (Cont.) Satellite Product Definition Block; Mode 6, Submode 20

NOTES: Figure 9-1 (Cont.):

10. LENGTH: Length of each scan line in the product in tens of minutes of arc, i.e., length must be multiplied by ten to obtain the actual value.

11. X,Y CENTER: The coordinates of the center of the product in units of the grid from which the product was extracted.

12. LATITUDE and LONGITUDE: The latitude and longitude of the center of the product in hundredths of degree, i.e., latitude and longitude must be multiplied by .01 to obtain the actual value.

13. NCHAR: The number of characters contained in the product title that follows.

14. CHARACTERs 1-n: The ASCII characters that make up the product title.

Figure 9-1. (Cont.) Satellite Product Definition Block; Mode 6, Submode 20

FF	LENGTH (I)
006	030
PI SET	MATRIX CODE
SCAN CODE	PACK CODE
CHECKSUM	

NOTES: Figure 9.2:

1. PI SET: The PI SET defines the background projection on which the product is valid. The currently defined codes are shown in Table C2-1. If a product is not associated with a background, PI SET will be zero (0) filled.

2. MATRIX CODE: A code defining the dimensions of the pixel array being sent in the product. Currently defined codes are:

01 - 512 x 512 x 1
02 - 512 x 512 x 2
03 - 512 x 512 x 3
04 - 512 x 512 x 4
05 - 512 x 512 x 5
06 - 512 x 512 x 6
07 - 512 x 512 x 7
10 - 512 x 512 x 8

11 - 1024 x 1024 x 1
12 - 1024 x 1024 x 2
13 - 1024 x 1024 x 3
14 - 1024 x 1024 x 4
15 - 1024 x 1024 x 5
16 - 1024 x 1024 x 6
17 - 1024 x 1024 x 7
20 - 1024 x 1024 x 8

21 - 2048 x 2048 x 1
22 - 2048 x 2048 x 2
23 - 2048 x 2048 x 3
24 - 2048 x 2048 x 4
25 - 2048 x 2048 x 5
26 - 2048 x 2048 x 6
27 - 2048 x 2048 x 7
30 - 2048 x 2048 x 8

41 - 4096 x 4096 x 1
42 - 4096 x 4096 x 2
43 - 4096 x 4096 x 3
44 - 4096 x 4096 x 4
45 - 4096 x 4096 x 5
46 - 4096 x 4096 x 6
47 - 4096 x 4096 x 7
50 - 4096 x 4096 x 8

63 - 1728 x n x 1 where n is dependent on the size of the product. In this case the number of data blocks must be counted during processing to determine n.

0 - M x N x 1 where M and N are dependent on the size of the product. In this case, M will be specified by the resolution element in the data block and the number of data blocks must be counted during processing to determine N.

Figure 9-2. Pixel Product Definition Block; Mode 6, Submode 30

NOTES: Figure 9.2:

3. SCAN CODE: Used to indicate the order in which the raster scan pixels are arranged in the data block. The currently used scan codes are:

1 - Data are arranged in the data block such that pixels are defined row by row (raster scan) from the upper left corner.

2 - Data are arranged in the data block such that the pixels are defined row by row (bottom up raster scan) from the lower left corner.

4. PACK CODE: A code defining the algorithm which was used to pack the product. Currently defined codes are:

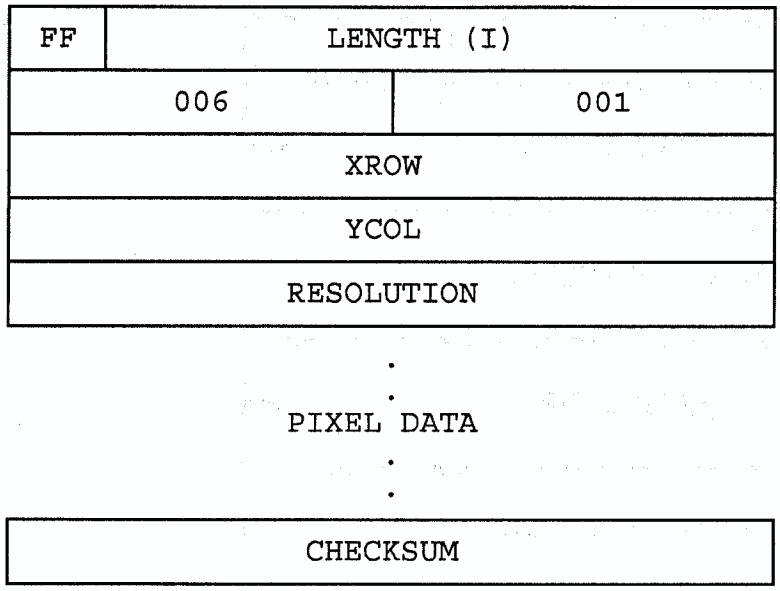
0 - Pixels are unpacked, i.e., each byte contains one pixel.

1 - Pixels are packed in accordance with the AFGWC packing scheme. See Section 9.3.1.1.

2 - Pixels are packed as specified by the Define Datawidth/Fieldwidth block. See Mode 1, Submode 5.

128 - Pixels are packed in accordance with the National Weather Service See Section 9.3.1.2.

Figure 9-2. (Cont.) Pixel Product Definition Block; Mode 6, Submode 30



NOTES:

1. XROW and YCOL: The row and column number, within the product, where the first pixel in the data block is located. For example, 0,0 specifies the first pixel is in row 0, column 0 while 36,492 specifies the first pixel is in row 36, column 492. This location is referenced to the scan direction indicated by the scan code, i.e., for top down scan sequence, 0,0 specifies the upper left corner while 36,492 specifies the 36th row from the top and the 492nd column from the left.

2. RESOLUTION: The number of pixels per scan line.

3. PIXEL DATA: The value, or state, of each pixel in the scan line.

Figure 9-3. Raster Scan Data Block; Mode 6, Submode 1

FF	LENGTH (I)
006	040
START PIXEL	
START SCANLINE	
STOP PIXEL	
STOP SCANLINE	
SATELLITE ID CHAR 1	SATELLITE ID CHAR 2
SATELLITE ID CHAR 3	SATELLITE ID CHAR 4
SATELLITE ID CHAR 5	SATELLITE ID CHAR 6
SENSOR TYPE CHAR 1	SENSOR TYPE CHAR 2
SENSOR TYPE CHAR 3	SENSOR TYPE CHAR 4
SENSOR TYPE CHAR 5	SENSOR CHANNEL
IMAGE BASE RESOLUTION	
IMAGE DECIMATION	
PALETTE FLAG	COLOR DEPTH
START SCANLINE OF COMPLETE IMAGE	
REFERENCE SCANLINE TIME	
SCAN CODE	PACK CODE
CHECKSUM	

Figure 9-4. Polar/Geosynchronous Image Product Definition Block; Mode 6, Submode 40

NOTES: Figure 9-4:

DEFINE SPECIFIC IMAGE TO BE DISPLAYED

1. START PIXEL: Left most pixel in a scanline for the requested image. Range 0..15,999.

2. START SCANLINE: Upper most scanline of the requested image. Range 0..15,999.

3. STOP PIXEL: Right most pixel of the requested image. Range START PIXEL + 1..16,000.

4. STOP SCANLINE: Lower right corner where requested image ends. Range START SCANLINE + 1..16,000.

5. SATELLITE ID CHARACTERS 1..6: A six character identifier of the satellite. May be blank filled.

e.g. *WX0000..WX9999 = DMSP*
NA0000..NA9999 = TIROS
GOESEb..GOESWb = GOES

6. SENSOR TYPE CHARACTERS 1..6: Identifies the sensor on the satellite the image represents. May be blank filled.

e.g. *AVHRR = TIROS*
VISSR = GOES
OLS, SSM/I, SSM/T = DMSP

7. SENSOR CHANNEL: Identifies the particular sensor of the sensor type from the satellite for this image, e.g.:

Visual = 1
Infrared = 2
AVHRR = 1..5
SSM/I = 1..7

IMAGE RESOLUTION

8. IMAGE BASE RESOLUTION: Identifies the base resolution of the satellite sensor. Units of 0.01 nautical miles.

e.g. *150 for DMSP SMOOTH (1.5 nm)*
30 for DMSP FINE (0.3 nm)

9. IMAGE DECIMATION: Identifies the scale relative to the base resolution of this image, e.g. a "2" indicates that every other original pixel has been deleted so the apparent resolution of the displayed image is one-half the original resolution. A negative number indicates pixel replication, e.g. a "-2" indicates that original pixels and scanlines have been replicated.

e.g. *base resolution = 150*
image decimation = 2
apparent resolution = 300 (3.0 nm)
e.g. *base resolution = 150*
image decimation = -2
apparent resolution = 75 (0.75 nm)

Figure 9-4. (Cont.) Polar/Geosynchronous Image Product Definition Block; Mode 6, Submode 40

NOTES: Figure 9-4 (Cont.):

COLOR SPECIFIC

10. PALETTE FLAG: Identifies whether a user specified color palette data block (Mode 1, Submode 12) is provided in the image product.

No Palette = 0 Palette is included = 1

11. COLOR DEPTH: The number of times the Color Palette Block (Mode 1, Submode 12) is repeated. This implicitly defines the maximum number of colors required for the product since each Color Palette Block can describe up to 256 colors or gray shades.

DESCRIBES ENTIRE IMAGE

12. START SCANLINE OF COMPLETE IMAGE: The first scanline of the entire pass from which this image was extracted. The pixel number will begin with zero for all images, but for some satellites the first scanline transmitted may be greater than zero. Range = 0 ... 15,999.

13. REFERENCE SCANLINE TIME: The time of the first scanline in the pass from which this image was extracted. The format is DDDHHMM where the fields are in the following ranges:

DDD = Day Range 0 ... 365
HH = Hour Range 0 ... 23
MM = Minute Range 0 ... 59

The integer number can be "unpacked" by taking the integer value of successive divisions.

e.g. 2750551 = 275th day, 0551 GMT
Day = INT (2750551 / 10000) = 275

14. SCAN CODE: Used to define the sequence of the transmitted image pixels arriving at the site. This describes how to reorder the pixels so an observer in space facing the north pole would see the image. Range 0 ... 3

North Oriented, Unmirrored Image = 0
South Oriented, Unmirrored Image = 1
North Oriented, Mirrored Image = 2
South Oriented, Mirrored Image = 3

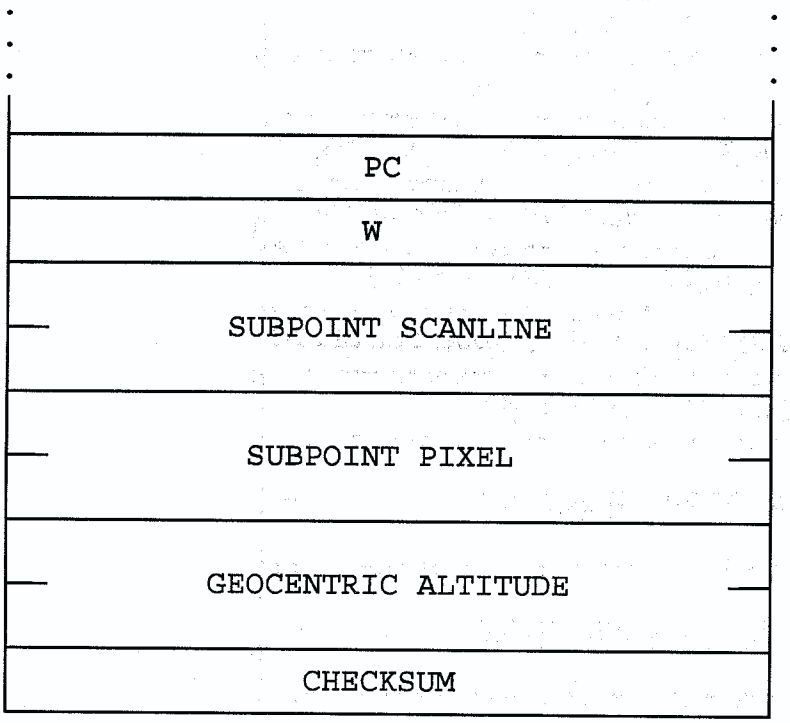
ADDITIONAL PACKING INFORMATION

15. PACK CODE: Used to indicate the data packing algorithm, if any. See existing pack code description in Mode 6, Submode 30 for current packing schemes.

Figure 9-4. (Cont.) Polar/Geosynchronous Image Product Definition Block; Mode 6, Submode 40

FF	LENGTH (I)
006	041
MNEMONIC CHARACTR 1	MNEMONIC CHARACTR 2
MNEMONIC CHARACTR 3	MNEMONIC CHARACTR 4
DATA REPRESENT CODE	UNITS CODE
MULTIPLIER MANTISSA	MULT CHARACTERISTIC
ADDITIVE CONSTANT	
LONGITUDE SUBPOINT	
LATITUDE SUBPOINT	
ALPHA	
DELTA	
ZETA	
ETA	
RHO	

Figure 9-5. Geosynchronous Image Product Description Block; Mode 6, Submode 41



NOTES: Figure 9-5:

DATA TYPE

1. MNEMONIC: A four character, left justified, set that identifies the type of data that is being represented by the image. Table A2-1 contains the mnemonic list.

DATA REPRESENTATION

2. DATA REPRESENTATION CODE: A code specifying the representation type of the data. Table C2-5 contains the codes. Examples of data representation are two's complement integer or floating point.

3. UNITS CODE: A code specifying the units of data. Table C2-4 contains these codes.

4. MULTIPLIER MANTISSA: Integer constant to be multiplied by the pixel value to obtain the actual value of the data point. Used in conjunction with the multiplier characteristic. See Figure 6-2, Note 12.

5. MULTIPLIER CHARACTERISTIC: Exponent of 10 to be used with the multiplier mantissa to obtain the true value of the data point.

Figure 9-5. (Cont.) Geosynchronous Image Product Description Block; Mode 6, Submode 41

NOTES: Figure 9-5 (Cont.):

SATELLITE LOCATION ABOVE EARTH

6. ADDITIVE CONSTANT: Integer constant to be added to the element value to obtain the true value of the data point.

7. LONGITUDE SUBPOINT: The longitudinal point between the satellite and the center of the earth. This value is used to determine the location in space of the satellite. The value is the longitudional angle in radians. Range -pi ... +pi, positive values indicate eastern hemisphere; negative values indicate western hemisphere.

8. LATITUDE SUBPOINT: The latitudinal point between the satellite and the center of the earth. This value is used to determine the location in space of the satellite. The value is the latitudinal angle in radians. Range -pi/2 ... +pi/2, positive values indicate northern hemisphere; negative values indicate southern hemisphere.

SATELLITE SPIN AXIS ORIENTATION

The ALPHA and DELTA values are with reference to a line from the center of the sun through the center of the earth, the inertial reference system. The combination of ALPHA and DELTA define the spin axis of the geostationary satellite.

9. ALPHA: The right ascension of the satellite spin axis. One of two parameters, given in radians, that define the orientation of the satellite spin axis relative to the initial reference system. Range 0 ... 2pi. Integer x 10^6.

10. DELTA: Declination of the satellite spin axis. One of two parameters, given in radians, that define the orientation of the satellite spin axis relative to the initial reference system. Range 0 ... 2pi. Integer x 10^6.

SATELLITE SENSOR ALIGNMENT

The ZETA, ETA, and RHO values correct for satellite yaw, pitch, and roll. The values account for and correct for instrument mounting and residual spacecraft errors.

11. ZETA: Line bias, given in radians, that defines an angle between an image reference line and the intersection of the image field of view and the satellite spin plane. It is analogous to pitch in an aircraft. Range 0 ... pi/2. Integer x 10^6.

12. ETA: Skew bias, given in radians, that defines an angle between field of view plane and the satellite spin vector. It is analogous to yaw in an aircraft. Range 0 ... pi. Integer x 10^6.

13. RHO: Element bias, given in radians, that defines a shift in the image in the east-west (the spin plane) direction. It is analogous to roll in an aircraft. Range 0 ... pi. Integer x 10^6.

Figure 9-5. (Cont.) Geosynchronous Image Product Description Block; Mode 6, Submode 41

NOTES: Figure 9-5 (Cont.):

ADDITIONAL POSITIONING VECTORS

14. PC: The absolute magnitude, given in nautical miles, of the satellite position vector relative to the inertial reference system. Generated from Chebychev polynomials, they are sent from the satellite during each transmission. Range is 0 .... 23,000.

15. W (Greenwich Hour Angle): Angular distance, given in 0.001 radians, from a reference line drawn from the center of the earth to the center of the sun at the time of the Vernal Equinox (spring) to the Greenwich Meridian. Range 0 ... 2 pi.

IMAGE PARAMETERS AT SATELLITE SUBPOINT

16. SUBPOINT SCANLINE: Scanline of the image corresponding to the satellite subpoint (point on earth intersected by the line from center of earth to satellite). It is used to relate scanlines to earth coordinates. Range 0 ... 182,200.

17. SUBPOINT PIXEL: Pixel of the image corresponding to the satellite subpoint. It is used to relate pixels to earth coordinates. Range 0 ... 382,300.

18. GEOCENTRIC ALTITUDE: The geocentric altitude of the satellite above the earth's surface defined in units of r, the distance from the center of the earth to the average earth's mean sea level. It is used to calculate view vector of the satellite. The value should be 6.611 for a geostationary satellite. Integer x 10^6.

Figure 9-5. (Cont.) Geosynchronous Image Product Description Block; Mode 6, Submode 41

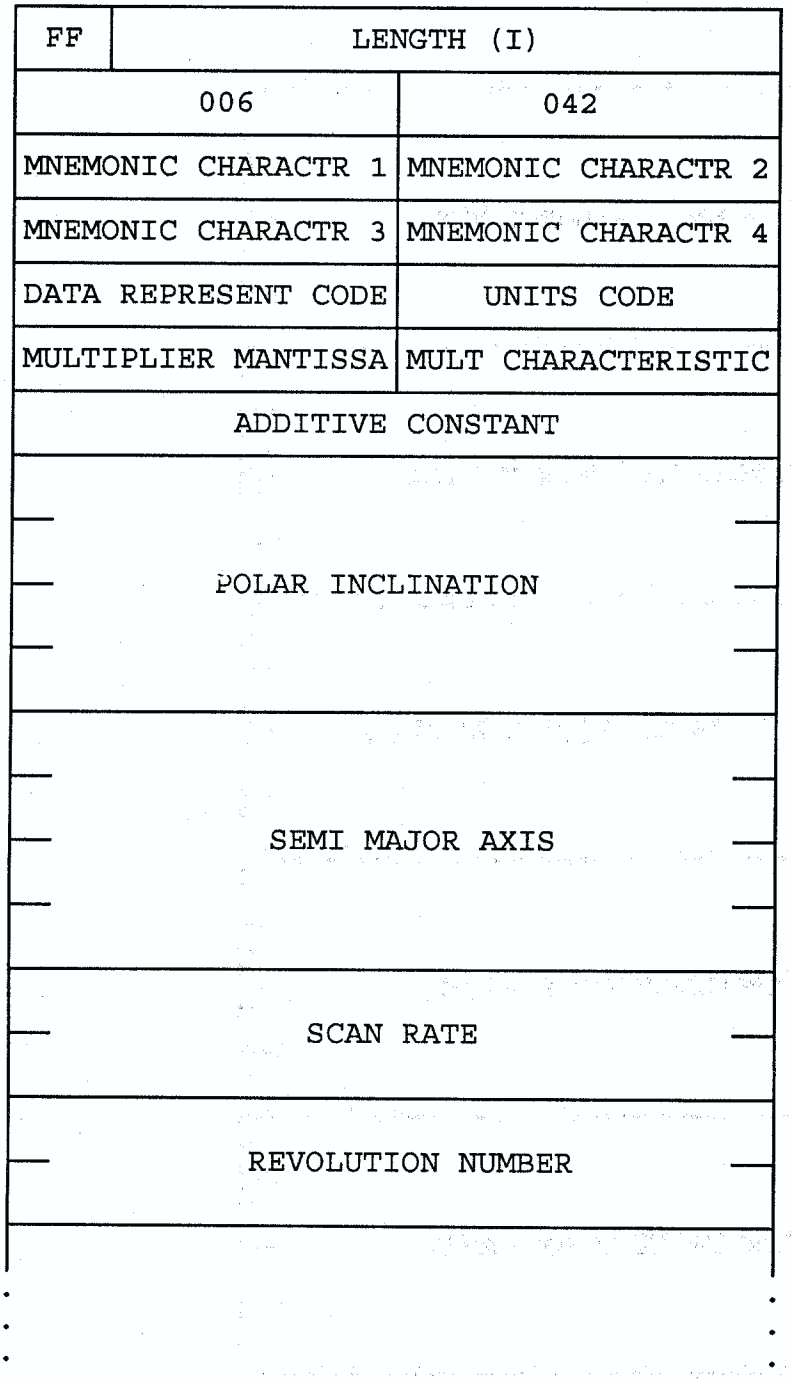


Figure 9-6. Polar Image Product Description Block; Mode 6, Submode 42

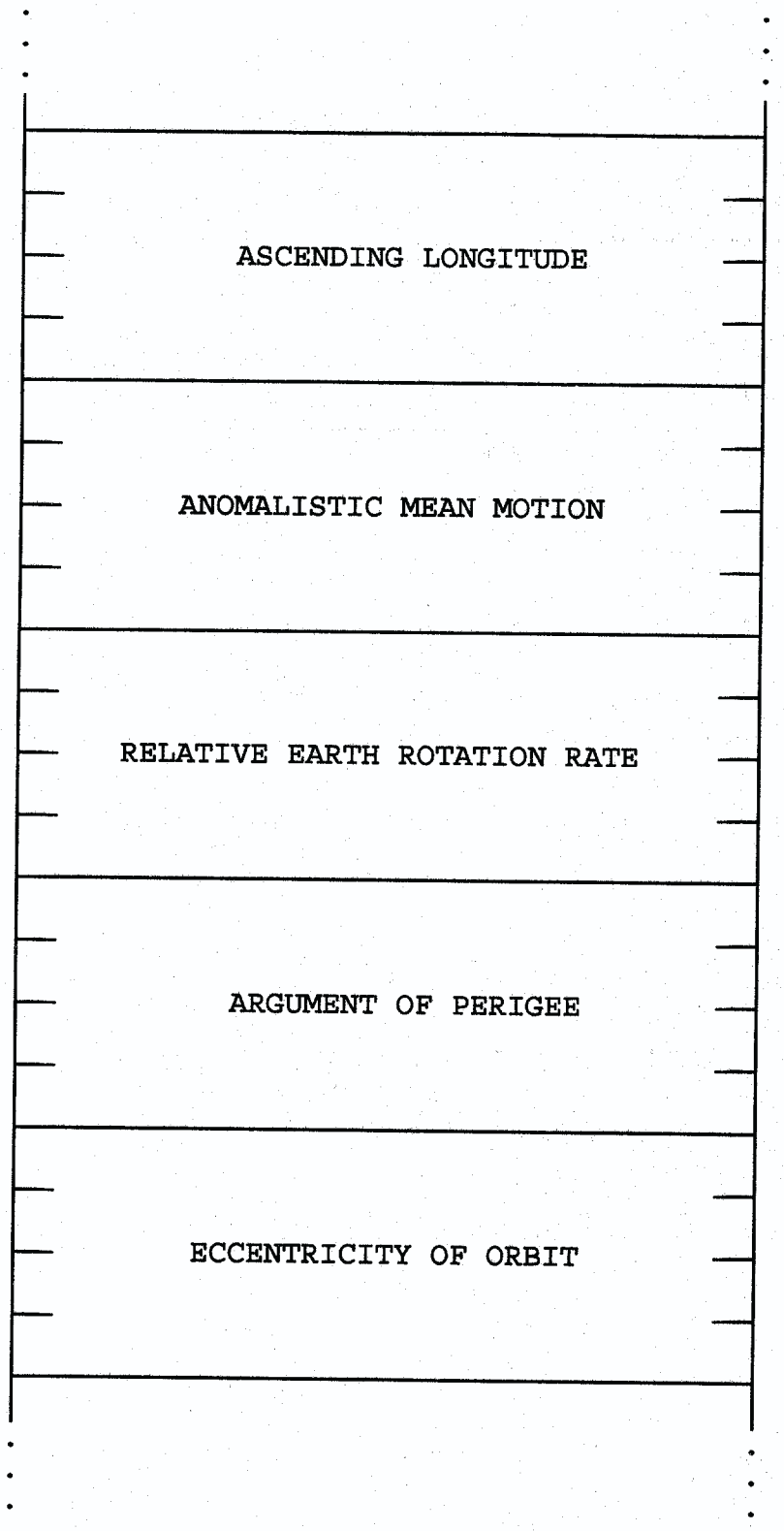


Figure 9-6. (Cont.) Polar Image Product Description Block; Mode 6, Submode 42

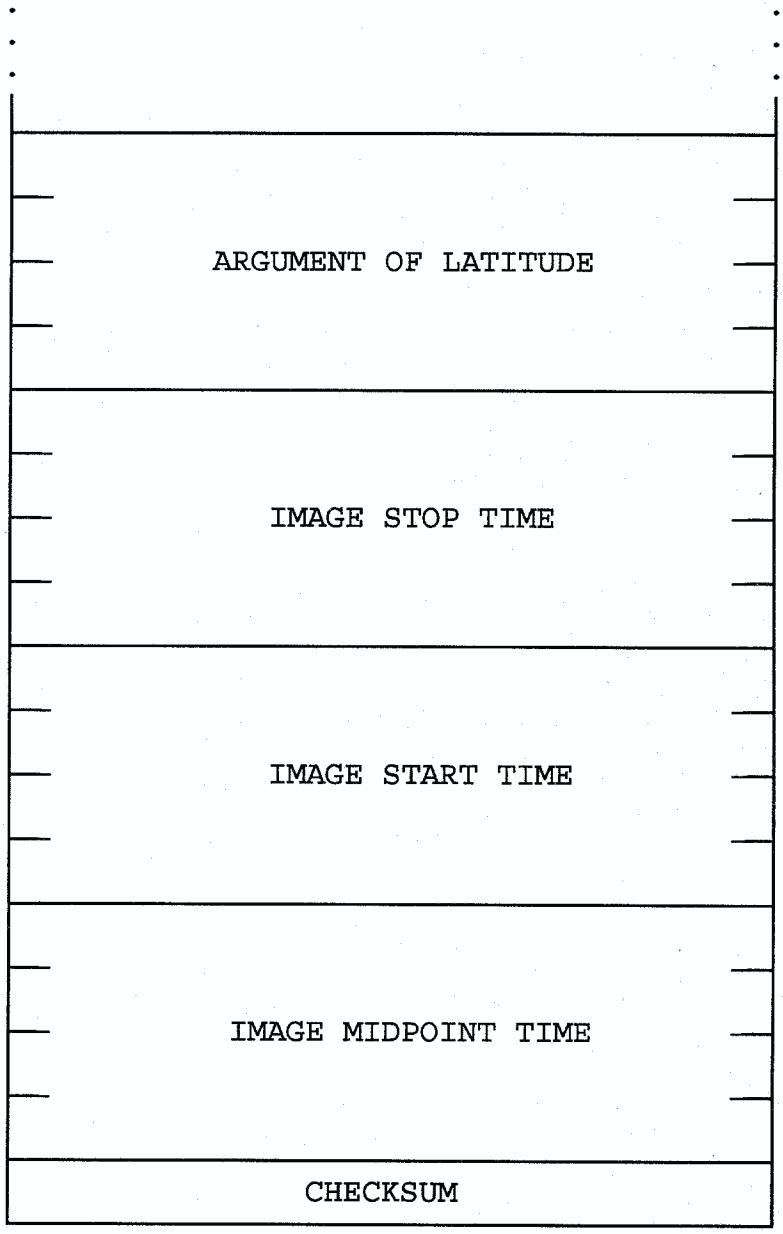


Figure 9-6. (Cont.) Polar Image Product Description Block; Mode 6, Submode 42

NOTES: Figure 9-6:

DATA TYPE

1. MNEMONIC: A four character, left justified, set that identifies the type of data that is being represented by the image. Table A2-1 contains the mnemonic list.

DATA REPRESENTATION

2. DATA REPRESENTATION CODE: A code specifying the representation type of the data. Table C2-5 contains the codes. Examples of data representation are two's complement integer or floating point.

3. UNITS CODE: A code specifying the units of data. Table C2-4 contains these codes.

4. MULTIPLIER MANTISSA: Integer constant to be multiplied by the pixel value to obtain the actual value of the data point. Used in conjunction with the multiplier characteristic. See Figure 6-2, Note 12.

5. MULTIPLIER CHARACTERISTIC: Exponent of 10 to be used with the multiplier mantissa to obtain the true value of the data point.

6. ADDITIVE CONSTANT: Integer constant to be added to the element value to obtain the true value of the data point.

ORBITAL INFORMATION WITH RESPECT TO THE EARTH

7. POLAR INCLINATION: The angular measure from the orbital plane of the satellite to the equatorial plane of the earth. The value is the angle in radians. Range 0 ... pi. Integer x 10^6.

8. SEMI MAJOR AXIS: One-half the length of a chord which passes through the foci of an ellipse. This is used to determine perigee and apogee of the satellite's orbit. Earth radii. Integer x 10^6.

SATELLITE INFORMATION

9. SCAN RATE: The average number of scans per second of the earth made by the line scanner. This number is used to determine the linear distance between scanlines.

10. REVOLUTION NUMBER: The orbit number of the satellite since launch used to determine the ephemeris set for the image.

ADDITIONAL ORBITAL INFORMATION

11. ASCENDING LONGITUDE: The longitude at which a northerly travelling satellite crosses the equatorial plane with respect to the line pointing from the earth to the center of the sun during the vernal equinox. One of the basic elements that defines the orbit. The value is an angle in radians. Range 0 ... 2pi. Integer x 10^6.

12. ANOMALISTIC MEAN MOTION: The number of orbits that a satellite makes in a 24 hour day. Another of the basic elements that is used to define the orbit of the satellite. This value varies with orbital decay and perturbations. The value is in radians per minute. Integer x 10^9.

Figure 9-6. (Cont.) Polar Image Product Description Block; Mode 6, Submode 42

NOTES: Figure 9-6 (Cont.):

13. RELATIVE EARTH ROTATIONAL RATE (Nodal Regression): The rate of rotation of the earth with respect to the satellite. Used to determine the orbit of the satellite. The value is in radians per minute. Integer x 10^9.

14. ARGUMENT OF PERIGEE: The number of degree the perigee is from ascending longitude. Fixes orientation of ellipse with respect to Aries. Also used to define the orbit of the satellite. The value is an angle in radians. Range 0 .. 2pi. Integer x 10^6.

15. ECCENTRICITY OF ORBIT: The eccentricity of elliptical path of the satellite orbit. Generally defined as c/a where c is the distance from the center of the ellipse to a foci and a is the intercept along the major axis. The eccentricity indicates the shape of the ellipse. Used also to define the orbit of the satellite. Range 0 .. 1. Integer x 10^9.

16. ARGUMENT OF LATITUDE: The number of degrees from the ascending node to the location of the satellite when the ephemeris data was generated. Position of satellite with respect to the ascending node. The value is an angle in radians. Range -pi/2 ... pi/2. Integer x 10^6.

SATELLITE TIMING INFORMATION

17. IMAGE STOP TIME: The delta time from the midpoint time to the time at which the sampling for this image was completed. The units are fractions of a day. The range is 0..1 where 1 is a day. Integer x 10^9.

18. IMAGE START TIME: The delta time at which the sampling for the image was started to the midpoint time of this image. The units are fractions of a day. The range is 0..1 where 1 is a day. Integer x 10^9.

19. IMAGE MIDPOINT TIME: The time of the central scanline in the requested image. The format of this field is yyddd.dddd... where yy is the year, ddd is the julian day, and .dddd... is the fractional part of the julian day. Integer x 10^6.

Figure 9-6. (Cont.) Polar Image Product Description Block; Mode 6, Submode 42